### PA-SI Program

math 3/3/16/

SEPA PART 1.	POTENTIAL HAZARDOUS WASTE SITE PRELIMINARY ASSESSMENT PART 1 - SITE INFORMATION AND ASSESSMENT			FICATION 2 SITE NUMBER 200 912 457	
II. SITE NAME AND LOCATION		STREET, ROUTE NO. OR SPE	OPO LOCATION OF STREET		
01 SITE NAME (Logal, common, or descriptive name of alley) $A + G Coal Co.$		5 1/2 of Sect	22 T.95R		
Harris burg Township OB COORDINATES LATITUDE LONG		STATE 05 ZIP CODE 06 CI	4 .	07COUNTY 08 CONG COOE 04ST 165 22	
og coordinates latitude LONG 37 43 00.0 0883.	1 58.0	Harrisbur	g (273)		
10 DIRECTIONS TO SITE ISlandy from nearest public reads  See Attached M	lap				
NI. RESPONSIBLE PARTIES					
OIOWNER (# known) Frank P. Parker Jr.		STREET (Business, meding, residen			
03 CITY		STATE 05 ZIP CODE	06 TELEPHONE NUMBER		
07 OPERATOR (It known and different from owner)  A & G Coal Co	08	STREET (Business, making, readon	tief	<del></del>	
OP CITY	10	STATE 11 ZIP CODE	12 TELEPHONE NUMBER		
13 TYPE OF OWNERSHIP (Check one)  A. PRIVATE B. FEDERAL:	(Agency name)	C. STATE	D.COUNTY DE.MU	NICIPAL	
F. OTHER:(Specify)	<del>,</del>	G. UNKNOW	N		
14 OWNER/OPERATOR NOTIFICATION ON FILE (Check all that apply)  A. RCRA 3001 DATE RECEIVED: / MONTH DAY YEAR	B. UNCONTROLLED	WASTE SITE (CERCLA 103 c)	DATE RECEIVED:/_MONTH_D	AV YEAR B'C. NONE	
IV. CHARACTERIZATION OF POTENTIAL HAZARD					
YES DATE A.E.	OCAL HEALTH OFFICIA	ONTRACTOR C.S.L. F. OTHER:		CONTRACTOR	
02 SITE STATUS (Check one)  A. ACTIVE B. INACTIVE C. UNKNOWN	RACTOR NAME(S):	NO NO NO YEAR ENDING YEAR	E/UNKNOW	ν	
04 DESCRIPTION OF SUBSTANCES POSSIBLY PRESENT, KNOWN, OR ALLEGED  Heavy Metals (Toxic /Persistant) Soluble)  Acids (Corrosive/Soluble)					
OS DESCRIPTION OF POTENTIAL HAZARD TO ENVIRONMENT ANDIOR POPULATION  Surface Water (Population/Environment)  Ground Water (Population/Environment)					
V. PRIORITY ASSESSMENT					
O1 PRIORITY FOR INSPECTION (Check one. If high or medium is checked, ce   A. HIGH B. MEDIUM (Inspection required promptly)	emplete Pay 3 - Waste Information & C. LOW (Inspect on time and	D. NONE	re Conditions and Incidents) Clion needed, complete current dispos	Man formy	
VI. INFORMATION AVAILABLE FROM					
01 CONTACT	02 OF (Agency/Organization	,	· · · · · · · · · · · · · · · · · · ·	03 TELEPHONE NUMBER	
04 PERSON RESPONSIBLE FOR ASSESSMENT  Richard M. Lange  EPA FORM 2070-12 (7-81)		RPM/PA-SI	07 TELEPHONE NUMBER 1217 1782-6761	OB DATE 3 24.86 MONTH DAY YEAR	

EPA Region 5 Records Ctr. 283214

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V		$\boldsymbol{\wedge}$

# POTENTIAL HAZARDOUS WASTE SITE

I. IDENTIFICATION 01 STATE 02 SITE NUMBER

<b>VEI</b>	74		PRELIMINARY PART 2 - WASTI			ILD 000	912451
IL WASTES	TATES, QUANTITIES, AND	CHARACTERI	STICS				
		2 WASTE QUANTI	TY AT SITE	03 WASTE CHARACT	ERISTICS (Check all Ina) a	ODIY	
SOLIO 8 POWDE C SLUDGI		TONS CUBIC YARDS	Un K	TOXIC CORRC C RADIO PERSIS	ACTIVE G FLAM	TIOUS J EXPLOS MABLE K REACTI	IVÉ VE 'ATIBLE
M. WASTE T							
CATEGORY	SUBSTANCE NAM	Æ	01 GROSS AMOUNT	02 UNIT OF MEASURE	03 COMMENTS		
SLU	SLUDGE						
OLW	OILY WASTE				1		
SOL	SOLVENTS						
PSD	PESTICIDES			• • •			
осс	OTHER ORGANIC CHE	MICALS					
IOC	INORGANIC CHEMICAL	.s					
ACD	ACIOS		Unk	rown	Mine	Spoils	
BAS	BASES						
MES	HEAVY METALS		Unkn	ONR	••	"	
IV. HAZARD	OUS SUBSTANCES (See Appe	ndia tai most traquant	y ciled CAS Numbers)	· · · · · · · · · · · · · · · · · · ·	·	Ţ.	
01 CATEGORY	02 SUBSTANCE NAM	<u> </u>	03 CAS NUMBER	04 STORAGE DIS	POSAL METHOD	05 CONCENTRATION	06 MEASURE OF CONCENTRATION
				//			
			KAA	WIC			
		IA	11100				
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							ļ.,
V. FEEDSTO	OCKS (See Appendix for CAS Mumbers	,					
CATEGORY	01 FEEDSTOCK	NAME	02 CAS NUMBER	CATEGORY	01 FEEDST	OCK NAME	02 CAS NUMBER
FDS				FDS			
FDS				FDS			
FDS				FDS			
FDS			I	FDS			
VI. SOURCE	S OF INFORMATION ICHE SE	ecific references e g	state files sample analysis i	eports (			
_	(SIA; 3	IL. Stat	te Reclama	tionPlan	for Aban	doned Mine	d Land)
	(County Pla	145;5I	A *00001	Cnty 165	; AML: Tr	<u>L-133</u> M	<u> </u>

**\$EPA** 

#### POTENTIAL HAZARDOUS WASTE SITE PRELIMINARY ASSESSMENT

PART 3 - DESCRIPTION OF HAZARDOUS CONDITIONS AND INCIDENTS

I. IDENTIFICATION

01 STATE 02 SITE NUMBER ILD 000 912 45/

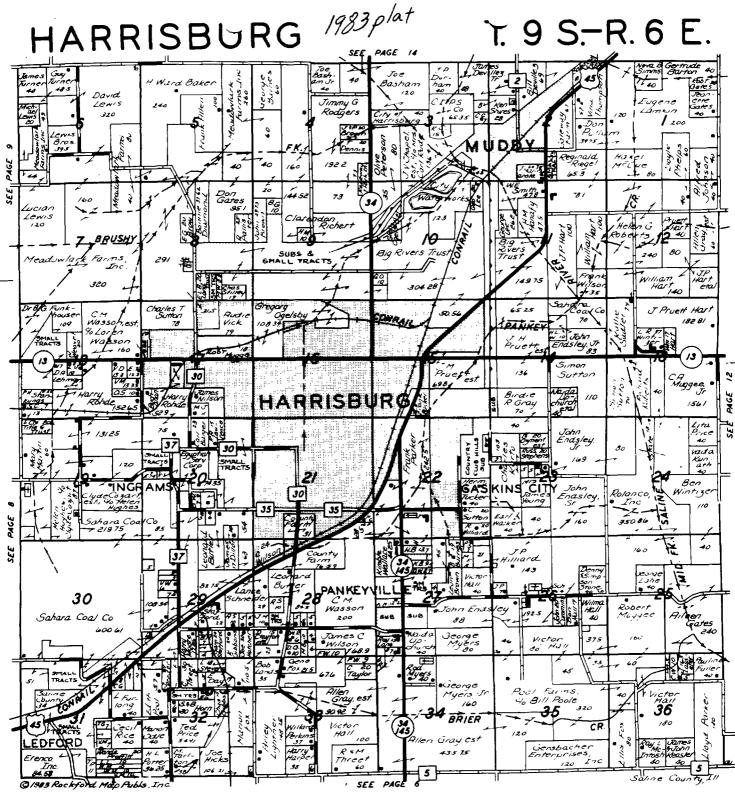
IL HAZARDOUS CONDITIONS AND INCIDENTS			
OI MA GROUNDWATER CONTAMINATION 03 POPULATION POTENTIALLY AFFECTED: Udt.  Rural pop. dependent of		OTENTIAL	: ALLEGED
OIL SURFACE WATER CONTAMINATION Udt. O3 POPULATION POTENTIALLY AFFECTED Udt.  Must public supplies  Supply. Extensive Recreat	04 NARRATIVE DESCRIPTION  utilize Surface water	POTENTIAL  - as sor  water.	ci ALLEGED
01 C CONTAMINATION OF AIR 03 POPULATION POTENTIALLY AFFECTED	02 COBSERVED(DATE)	, POTENTIAL	C: ALLEGED
01 © D FIRE:EXPLOSIVE CONDITIONS 03 POPULATION POTENTIALLY AFFECTED	02 © OBSERVED (DATE) 04 NARRATIVE DESCRIPTION	(_ POTENTIAL	□ ALLEGED
01 C E DIRECT CONTACT 03 POPULATION POTENTIALLY AFFECTED	02 C OBSERVED (DATE) 04 NARRATIVE DESCRIPTION	□ POTENTIAL	. ALLEGED
01 : F CONTAMINATION OF SOIL 03 AREA POTENTIALLY AFFECTED (Acres)	02 © OBSERVED (DATE I 04 NARRATIVE DESCRIPTION	POTENTIAL	. ALLEGED
OILG DRINKING WATER CONTAMINATION 03 POPULATION POTENTIALLY AFFECTED LIGHT  See A&B all	02 () OBSERVED (DATE) 04 NARRATIVE DESCRIPTION	<b>WPOTENTIAL</b>	ALLEGED
01 TH WORKER EXPOSURE INJURY 03 WORKERS POTENTIALLY AFFECTED.	02 CL OBSERVED (DATE) 04 NARRATIVE DESCRIPTION	□ POTENTIAL	C) ALLEGED
01 JI POPULATION EXPOSURE/INJURY 03 POPULATION POTENTIALLY AFFECTED	02 [] OBSERVED (DATE) 04 NARRATIVE DESCRIPTION	ij potential	□ ALLEGED

## POTENTIAL HAZARDOUS WASTE SITE

I. IDENTIFICATION 01 STATE 02 SITE NUMBER

HAZARDOUS CONDITIONS AND INCIDENTS (Continued			
, HAZARDOUS CONDITIONS AND INCIDENTS (Communic D1   J. DAMAGE TO FLORA D4 NARRATIVE DESCRIPTION	02 - OBSERVED (DATE)	□ POTENTIAL	□ ALLEGED
DI BR. DAMAGE TO FAUNA NA NARRATIVE DESCRIPTION (Include name) of loocue)  Extensive Sport fish,	oz observed (Date) ing industry in this	EFOTENTIAL LYCA.	□ ALLEGED
21 BL. CONTAMINATION OF FOOD CHAIN 14 NARRATIVE DESCRIPTION  Consum prior of	5port fish.	E FOTENTIAL	□ ALLEGED
01 [] M UNSTABLE CONTAINMENT OF WASTES (Soils runoff standing lounds leading drums) 03 POPULATION POTENTIALLY AFFECTED	02 OBSERVED (DATE:) 04 NARRATIVE DESCRIPTION	□ POTENTIAL	□ ALLEGED
01 ( N. DAMAGE TO OFFSITE PROPERTY 04 NARRATIVE DESCRIPTION	02 (; OBSERVED (DATE)	☐ POTENTIAL	□ ALLEGED
01 C O CONTAMINATION OF SEWERS, STORM DRAINS, W 14 NARRATIVE DESCRIPTION	WTPs 02 - OBSERVED (DATE:)	□ POTENTIAL .	□ ALLEGED
DI [] P ILLEGAL/UNAUTHORIZED DUMPING NARRATIVE DESCRIPTION	02 C OBSERVED (DATE)	□ POTENTIAL	□ ALLEGED
DS DESCRIPTION OF ANY OTHER KNOWN, POTENTIAL, OR	ALLEGED HAZARDS		
I. TOTAL POPULATION POTENTIALLY AFFECTED: /. COMMENTS	udt.		
. SOURCES OF INFORMATION (Cae specific reterences, e.g., si	Total films Assessed Makerial (Money)		
·			





### BRAD RAGAN, INC.

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BRi

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#### **EXECUTIVE SUMMARY**

This site has been placed in the ERRIS/CERCLIS data base as a result of its identification during the Surface Impoundment Assessment (SIA). Certain other sites have recently been added to CERCLIS because of their similar ownership, operator, or proximity to an identified SIA site. The information contained in Section II Site Name and Location: items 01 thru 10 may be found to vary from the existing CERCLIS information; the information contained on EPA Form 2070-12 should be used henceforth as more accurately identifying the site name and location.

Information to complete Form 2070-12 has been acquired from a number of sources including, but not limited to, SIA printouts, CERCLIS, the Illinois State Reclamation Plan for Abandoned Mined Land, and county plat books. Considering the age, of certain information, and the lack of specificity, some interpretation and judgement has been required in reporting all information. Where duplication of material with a moderate confidence level occurred, that information has been reported. Where conflicting data has appeared, the most current information with the highest degree of confidence has been used.

The materials of major concern at this location, with potential environmental impact, would be gob piles, acid mine drainage, and impoundments to retain mine drainage and coal wash plant process waters. Low pH and high iron concentrations have long been associated with mine drainage. Iron pyrites and marcasites (FeS $_2$ ) constitute approximately 25% of the mineral fraction of Illinois coals and thru a complex oxidation reaction yield H $_2$ SO $_4$  and FeSO $_4$  providing the sources for low pH and Fe release problems. More recent concerns are being raised because of the heavy metal constituents of mine run coal, which are contained primarily in the mineral fraction and removed to the gob pile, with the pyrites, during initial processing.

USEPA publication EPA-650/2-74-054 summarizes work done by the Illinois State Geological Survey and raises points of concern for this area of Illinois. Pages 33 thru 50 of this report summarize analytical results obtained on four major Illinois coals and fractions of the coals obtained by specific gravity separation techniques. Looking at the Herrin #6 coal member, fractions of 1.60 specific gravity and greater, metals are reported in the following ranges.

	Low	<u>High</u>		Low	<u>High</u>
As:	23.0	244.0 ppm	Ni:	76	102 ppm
Cd:	4.8	152.0 ppm	Pb:	210	2162 ppm
Cr:	31	71.0 ppm	Sb:	2.8	12.0 ppm
Cu:	61	89.0 ppm	Se:	6.8	21.0 ppm
Hg:	0.68	3.80 ppm	۷:	60	85 ppm
Mn:	74	457 ppm	Zn:	570	15170 ppm
Mo:	14	215 ppm	Zr:	21	32 ppm

Comparing the above information against surface water quality data reported in "Hydrology of Area 35, Eastern Region, Interior Coal Province, Illinois and Kentucky" published by the U.S. Dept. of Interior, Geologic Survey; open file report #81-403, portions of which are attached, one begins to grasp the potentials for environmental degradation presented by mine drainage. In the USGS study, the maximum concentration of Ni found upstream of mining activity was 10 ppb, whereas downstream, the maximum value was 630 ppb. Mean values of Ni found were 6.1 ppb upstream, and 113 ppb downstream. The values for Ni represent a 63 fold increase of downstream maximum over the upstream maximum. Increases in the maximum concentrations of Cu were 27 fold, Zn at 32 fold, Mg at 11.9 fold, and Al at 2,238 fold increase.

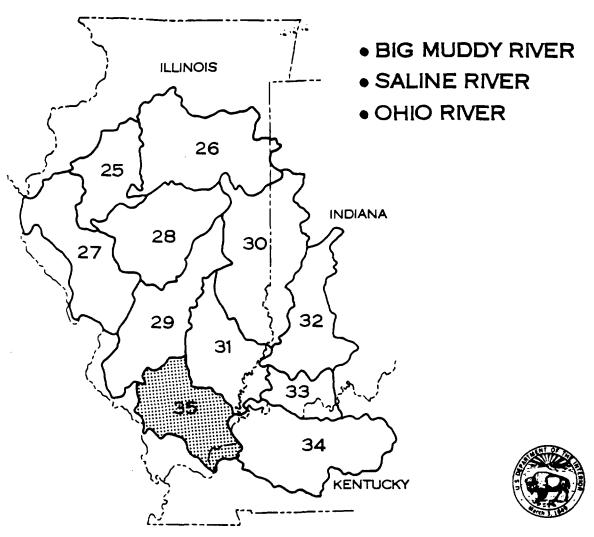
The Illinois Department of Mines and Minerals and numerous private firms are involved in reclamation/remediation activities at a number of these sites. It is entirely possible that this site presents no hazard at this time, but the reverse is also possible. There is no evidence to indicate waste disposal, other than that associated with mine activity. A low priority has been assigned and site inspection activity should be considered on a representative selection of these sites on a time available basis. A higher priority was not assigned because of the regional scope of these sites and the high probability of existing remedial activities at high pollution potential sites.

RML:tk:4/8/49(3/21/86)

Attachment



### HYDROLOGY OF AREA 35, EASTERN REGION, INTERIOR COAL PROVINCE, ILLINOIS AND KENTUCKY



UNITED STATES DEPARTMENT OF THE INTERIOR GEOLOGICAL SURVEY

WATER-RESOURCES INVESTIGATIONS OPEN-FILE REPORT 81-403

#### HYDROLOGY OF AREA 35, EASTERN REGION, INTERIOR COAL PROVINCE, ILLINOIS AND KENTUCKY

BY

E.E. ZUEHLS, G.L. RYAN, D.B. PEART, AND K.K. FITZGERALD

U.S. GEOLOGICAL SURVEY WATER-RESOURCES INVESTIGATIONS 81-403



## 8.0 SURFACE WATER (Continued) 8.2 SURFACE-WATER QUALITY (Continued) 8.2.4 IRON

### IRON CONCENTRATIONS ARE HIGHER DOWNSTREAM THAN UPSTREAM OF MINING

Dissolved iron ranged from 0 to 640 micrograms per liter ( $\mu$ g/L) at sites upstream of mining and from 0 to 1,100,000  $\mu$ g/L at sites downstream of mining. Total recoverable iron ranged from 100 to 31,000  $\mu$ g/L at the upstream sites and from 0 to 2,100,000  $\mu$ g/L at the downstream sites.

Iron is the fourth most abundant element in the Earth's crust with 4.7 percent (Petrucci, 1972). It is an important constituent of the surface and ground waters in this area because of its abundance in the sedimentary rocks of the Pennsylvanian System. Under natural conditions, in sedimentary rock and ground water, iron is found primarily in the ferrous form (Fe<sup>+2</sup>). It is the abundance and the instability of ferrous iron, when exposed to air, that probably influence many chemical reactions downstream of mining. Surface-mining processes increase the amount of iron available to the system by exposing more surface area of iron-bearing minerals to weathering conditions. Geologic and erosional factors at sites upstream of mining maintain fairly stable concentrations of iron in streams.

At sites upstream of mining, the measured range of concentration for dissolved iron was from 0 to 640  $\mu$ g/L with a mean of about 110  $\mu$ g/L. At sites downstream of

mining, concentrations of dissolved iron ranged from 0 to 1,100,000  $\mu$ g/L with a mean of about 20,000  $\mu$ g/L or approximately 20 milligrams per liter (mg/L) (fig. 8.2.4-1 and 8.2.4-2 and table 8.2.4-1).

Total recoverable iron for the sites upstream of mining ranged from 100 to 31,000  $\mu$ g/L with a mean of about 2,400  $\mu$ g/L. Total recoverable iron for the downstream sites ranged from 0 to 2,100,000  $\mu$ g/L with a mean of about 37,800  $\mu$ g/L or approximately 38 mg/L (fig. 8.2.4-1 and 8.2.4-3 and table 8.2.4-2).

Concentrations of dissolved iron in surface water seldom reach 1 mg/L (American Public Health Association, 1976, p. 207). For the upstream sites, the entire range of values is well below this level. The surface water of areas downstream of mining sometimes exceeded 1 mg/L of dissolved iron.

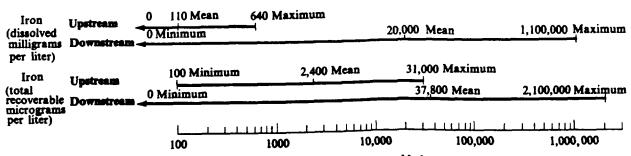


Figure 8.2.4-1 Range of dissolved iron and total recoverable iron concentrations measured at sites upstream and downstream of mining

## 8.0 SURFACE WATER (Continued) 8.2 SURFACE-WATER QUALITY (Continued) 8.2.5 MANGANESE

#### CONCENTRATIONS OF DISSOLVED AND TOTAL RECOVERABLE MANGANESE ARE HIGHER DOWNSTREAM THAN UPSTREAM OF MINING

Mean values of dissolved and total recoverable manganese concentrations were approximately 7 to 10 times greater at the sites downstream of mining than at the upstream sites.

Manganese is a common element widely distributed in igneous rocks and soils, but its total abundance in the Earth's crust is small enough to put it in the list of trace" elements. Manganese and iron have similar electronic configurations and behave similarly. Because manganese has a lower affinity for oxygen, it stays in solution longer than iron (Rankama and Sahama, 1950).

For the sites upstream of mining in the study area, the measured concentrations of dissolved manganese ranged from 30 to 4,900 micrograms per liter ( $\mu g/L$ ) with a mean of about 560  $\mu g/L$ . This compares to a measured range of 20 to 91,000  $\mu g/L$  and a mean of about 4,100  $\mu g/L$  for the sites downstream of mining (fig. 8.2.5-1 and 8.2.5-2 and table 8.2.5-1).

Total recoverable manganese for the sites upstream of mining ranged from 30 to 3,900  $\mu$ g/L with a mean of

about 570  $\mu$ g/L. Downstream of mining the measured values of total recoverable manganese ranged from 20 to 240,000  $\mu$ g/L with a mean of about 5,590  $\mu$ g/L (fig. 8.2.5-1 and 8.2.5-3 and table 8.2.5-2).

According to Rankama and Sahama (1950) the Mn:Fe ratio in natural carbonate waters is about 5:1. This ratio is approximated by the upstream data for which the mean dissolved manganese value was  $560 \mu g/L$  and the mean dissolved iron value was  $110 \mu g/L$ . The mean values of dissolved manganese and dissolved iron for the downstream sites are  $4,100 \mu g/L$  and  $20,000 \mu g/L$ , respectively, resulting in a Mn:Fe ratio of 0.21:1. This decrease in the Mn:Fe ratio reflects the relatively large upstream to downstream increase in iron concentrations compared to manganese concentrations.

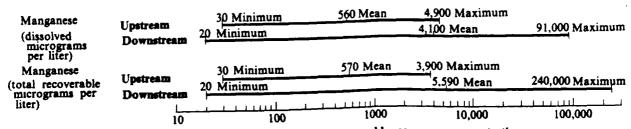


Figure 8.2.5-1 Range of dissolved and total recoverable manganese concentrations measured at sites upstream and downstream of mining

# 8.0 SURFACE WATER (Continued) 8.2 SURFACE-WATER QUALITY (Continued) 8.2.6 SULFATE

#### SULFATE CONCENTRATIONS ARE HIGHER DOWNSTREAM THAN UPSTREAM OF MINING

Concentrations of sulfate ranged from 12 to 500 milligrams per liter (mg/L) at the sites upstream of mining and from 15 to 12,000 mg/L at the downstream sites. Sulfate concentrations at downstream sites can be estimated using the equation:

SULFATE = 0.64 (SPECIFIC CONDUCTANCE) — 210.

Sulfur occurs in the coal and associated strata as metallic sulfides, mainly in the form of pyrite (FeS<sub>2</sub>) and marcasite (FeS<sub>2</sub>), which are also sources of ferrous iron. When oxidized, the sulfides yield the sulfate ion and ferric oxide. At the sites upstream of mining, the sulfates are probably introduced to the water from stream cuts through exposed Pennsylvanian rocks. This would be a fairly steady source of sulfate with erosion and oxidation contributing to the dissolution of sulfate materials.

The measured concentrations of sulfate at the upstream sites range from 12 to 500 mg/L with a mean value of 140 mg/L for all the observations at all the upstream sites. The upstream sulfate data contrast sharply with sulfate data for the downstream sites (table 8.2.6-1). The mean downstream sulfate value of 760 mg/L is larger than any value at an upstream site, and the maximum value of 12,000 mg/L is 24 times that of the largest value found at an upstream site (fig. 8.2.6-1). The minimum sulfate value of 15 mg/L at the downstream sites is approximately the same as the minimum at the upstream sites.

The contrast in sulfate concentrations between the sites upstream and downstream of mining, as seen in figure 8.2.6-2, suggests the higher sulfate concentrations downstream of mining probably result from the increased exposure of sulfide-bearing minerals to weathering in the mined area. Toler (1980) related annual sulfate loads to the area of surface mines as a percentage of total drainage area and showed that in southern Illinois sulfate can be used as an indicator of mine drainage (fig. 8.2.6-3).

For the sites downstream of mining a comparison was made between sulfate concentrations and specific conductance. There is a strong correlation (correlation coefficient = 0.93) between the two variables in the range for specific conductance from 400 to 5,000  $\mu$ mho/cm at 25°C. By using the regression equation represented by the line on the accompanying illustration (fig. 8.2.6-4), sulfate concentrations can be estimated at sites in the area downstream of mining from measurements of specific conductance between 400 and 5,000  $\mu$ mho/cm at 25°C.

## 8.0 SURFACE WATER (Continued) 8.2 SURFACE-WATER QUALITY (Continued) 8.2.7 ALKALINITY AND ACIDITY

### ACIDITY VALUES ARE HIGHER DOWNSTREAM THAN UPSTREAM OF SURFACE MINING AREAS

Only one site upstream of mining had measurable acidity. Twenty-one sites downstream of mining had acidity values ranging from 0.1 to 99 milligrams per liter (mg/L) as the hydrogen ion (H<sup>+</sup>). Alkalinity values ranged from 0 to 390 mg/L as calcium carbonate (CaCO<sub>3</sub>) at the upstream sites and from 0 to 520 mg/L as CaCO<sub>3</sub> at the downstream sites.

Acidity is defined as "the quantitative capacity of an aqueous media to react with hydroxyl ions" and is expressed in mg/L as the hydrogen ion (H\*). It is an important parameter to measure in areas affected by surface mining because when present in significant amounts it is an indication that acid-forming materials are interacting with the surface water. Alkalinity is defined as the capacity of the solution to react with hydrogen ions and is commonly reported in mg/L as CaCO<sub>3</sub> even though CaCO<sub>3</sub> may not be the source of or be responsible for all the buffering capability.

One site upstream of mining had measurable acidity. Twenty-three of forty-eight sites downstream of mining had measurable acidity that ranged from 0.1 to 99 mg/L as H<sup>+</sup> (fig. 8.2.7-1 and 8.2.7-2 and table 8.2.7-1).

Alkalinity at sites upstream of mining ranged from 0 to 390 mg/L as CaCO<sub>3</sub> with a mean of 92 mg/L as CaCO<sub>3</sub>. The sites downstream of mining had a range in alkalinity from 0 to 520 mg/L as CaCO<sub>3</sub> with a mean of 88 mg/L (fig. 8.2.7-1 and table 8.2.7-2).

Although mean values for alkalinity at the upstream and downstream sites are similar (fig. 8.2.7-3), variations between sites, especially downstream of mining, are great. Surface mining exposes not only the pyrites and marcasites (acid-forming materials) but also the limestones (source of CaCO<sub>3</sub>) of the Pennsylvanian System. The variability of alkalinity values at the sites downstream of mining may depend on the amounts of limestone exposed during mining.

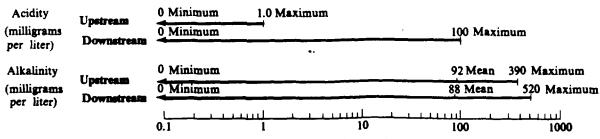


Figure 8.2.7-1 Range of acidity and alkalimity values at sites upstream and downstream of mining

# 8.0 SURFACE WATER (Continued) 8.2 SURFACE-WATER QUALITY (Continued) 8.2.8 TRACE ELEMENTS AND OTHER CONSTITUENTS

### CONCENTRATIONS OF TRACE ELEMENTS VARY IN THE STUDY AREA

Concentrations of many trace elements and other water-quality constituents differed between sites upstream and downstream of surface mining.

Concentrations of many dissolved constituents differed between sites upstream and downstream of mining as shown in figure 8.2.8-1. In water, copper, zinc, boron, calcium, nickel, magnesium, and aluminum all had higher mean concentrations downstream of mining than upstream. Concentrations of carbon dioxide in

water and total iron in the bottom material were also higher downstream of mining. Mean concentrations of total manganese in bottom material showed little difference between upstream and downstream sites. Dissolved chloride concentrations were less downstream than upstream of mining.

0.5 Minimum 6 Mean Carbon Dioxide 12 38 Upstream 7.9 Mean 67 Maximum 0 Minimum 44 249 0 Minimum 2.8 Mean 10 Maximum 25 **Upstream** 13 Mean 270 Maximum 32 332 Downstream 22 Mean 0 Migimus 270 Махирия 25 Ziec Upstream 237 Mcan 0 Minimum 8,800 Maximum 32 223 42 Mean 140 Maximum 0 Minimum . Upstream 2 30 Minimum 302 Mesa 1,300 Maximum 45 2 11 Colcins Upetream 101 Downstream Minimum Mean Maximum 6.1 10 ŧO Nickel Upetrese. 113 Mean Minimum 51 Downstream Minimum Mean Maximum 23 36 4.8 2 11 45 Minimum 430 Maximum 107 Downstream 74 Mean 75 Uperream 22 Mean 115 Maximum 2 Minimum 384 Maximum 7.700 18,700 63,000 10 Upstream 8,800 Minimum 32,900 Mean 170,000 Maximum Downstream 24 22 Mean Maximum 910 2 600 Upstream 10 910 Mean 2700 Maximum 23 23 210 Maximum 53 Mcan 0 Minimum 24 Upatream 8,200 Mean 0 Милітив Maximum 470,000 204 31 10,000 1,000 100,000

Figure 8.2.8-1 Range of concentrations for various constituents at sizes upstream and downstream of mining.